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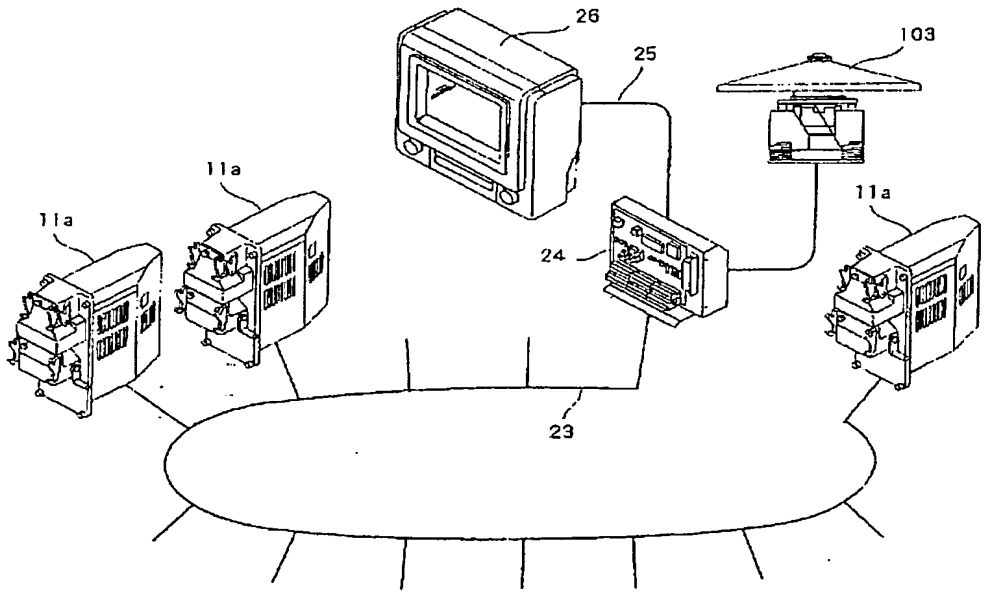
(54) Weighing system

(57) Provided is a system having excellent quick response to control information and capable of easily adding and changing hardware. A weighing driving section 12 is provided on each weighing unit 11 forming a combination scale. The weighing driving section 12 is formed by a CPU board 13, motor drivers 14 and 15 for driving stepping motors 18 and 19, an A/D converter 16 for A/D converting a weighed value sent from a load cell 20, and a feeder driver 17 for driving a feeder 21. The CPU board 13 is connected to a LAN cable 23 through a LAN interface 22. A weighing control unit 26 for giving control information to the weighing driving section 12 of the weighing unit 11 is provided. The weighing control unit 26 is connected to the LAN cable 23 through a LAN board.

Fig. 2



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a weighing system, and more particularly to a weighing system in which a weighing driving section of each of a plurality of weighing units, a weighing control section for controlling the weighing driving section and the like are coupled through a LAN.

Description of the Related Art

Conventionally, a weighing system which functions as a combination scale has been used to feed, to a packer, an article to be weighed within the range of a predetermined weight. In such a weighing system, the article to be weighed within the range of the predetermined weight is fed from each weighing unit forming the weighing system to the packer. The weighing unit includes a hopper, a load cell and the like. The hopper, the load cell and the like are usually controlled by a weighing control unit formed by a single CPU.

If the number of the weighing units forming the weighing system becomes larger, a load on the CPU is increased. For this reason, the single CPU cannot completely perform processing in some cases. Therefore, a structure in which a plurality of CPUs are provided to share the processing thereof is sometimes employed. In some cases where the load is further increased, a weighing system is employed in which a weighing driving section formed by a single CPU is provided for each weighing unit. With the structure in which one weighing driving section is provided for each weighing unit, a weighing control unit having one CPU for controlling the whole combination scale is usually provided. The weighing control unit is connected, through an ordinary serial telecommunication line, to all the weighing driving sections provided on the weighing units.

With the structure in which the weighing driving sections are provided, however, the weighing driving sections are connected to the weighing control units through the telecommunication line as described above. Therefore, if the number of the weighing units is increased or a packing speed of the packer is increased, it is impossible to keep quick response to data such as operating conditions or control information between the weighing control section of the weighing control unit and the weighing driving section of the weighing unit. If a program to be executed by the weighing driving section should be exchanged to perform version up on the program or the like, it is necessary to exchange the program of all the weighing driving sections. Furthermore, abnormalities of the telecommunication line such as disconnection are found with difficulty if they are caused.

SUMMARY OF THE INVENTION

In order to solve the above-mentioned problems of the prior art, it is an object of the present invention to provide a weighing system which is excellent in quick response to data such as operating conditions or control information, can easily exchange a program to be executed by each weighing driving section, and can easily detect abnormalities of a LAN such as disconnection.

The present invention provides a weighing system in which quick response to control information, operating information or the like can be achieved by connecting a weighing driving section of each weighing unit and a weighing control unit through a LAN capable of performing high-speed communication. Furthermore, an execution program of the weighing driving section can be exchanged to perform version up or the like at a high speed by using the LAN. In addition, a diagnostic function of the LAN can easily be fulfilled by sending, to each weighing unit, necessary operating information when starting the weighing system and sending various continuous instructions during operation, and judging that the weighing unit to which a response signal has been sent is normal and that the weighing unit to which the response signal has not been sent is abnormal.

The problems of the prior art can be solved by employing the LAN for the weighing system forming the combination scale according to the present invention. More specifically, the weighing driving section of the weighing unit is coupled to the weighing control section of the weighing control unit trough the LAN so that the control information and data can be transferred at a high speed.

Also in the case where the program of the weighing driving section of the weighing unit is changed with version up, it can be transferred at a high speed from the weighing control section of the weighing control unit through the LAN. Accordingly, it is possible to shorten a time to perform the version up on the program in the weighing control section.

Furthermore, the LAN is employed so that it is possible to confirm that the operating information and the instructions are sent and received to and from the weighing unit. Consequently, the weighing control section and the like can have the diagnostic function easily. Accordingly, abnormalities of the LAN can easily be detected before the operation of the weighing system is started or during the operation.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a block diagram showing a schematic structure of a weighing system according to an embodiment of the present invention;

Figure 2 is a view conceptually showing the weighing system in Figure 1;

Figure 3 is a perspective view showing a structure of a weighing unit in Figure 1;

Figure 4 is a block diagram showing a structure of a feed - discharge control section in Figure 1;
Figure 5 is a perspective view showing an external structure ofthe weighing system in Figure 1;
Figure 6 is a diagram showing an example of control information to be used for the weighing system in Figure 1;
Figure 7 is a block diagram showing a schematic structure of a weighing and packing system according to another embodiment of the present invention; and
Figure 8 is a block diagram showing a schematic structure of a packing system according to an embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Fig. 1 is a block diagram showing a schematic structure of a weighing system 10 according to an embodiment of the present invention. Fig. 2 is a view conceptually showing the weighing system 10. Fig. 3 is a perspective view showing a structure of a weighing unit 11 which will be described below. As shown in Fig. 1, the weighing system 10 according to the present embodiment has a structure in which a combination scale (not shown) is formed by a plurality of weighing units 11, each of which has a weighing driving section 12 for performing weighing operation. The weighing driving section 12 includes a CPU board 13, motor drivers 14 and 15 for driving stepping motors 18 and 19 respectively, an A / D converter 16 for A/ D converting a weighed value of an article to be weighed which is sent from a load cell 20, and a feeder driver 17 for driving a feeder 21. The CPU board 13 has a flash memory 13a for storing an execution program and the like. In the present embodiment, the weighing unit 11 does not include the feeder 21 but the feeder driver 17.

The CPU board 13 is connected to a LAN cable 23 through a LAN interface 22. While the feeder driver 17 is included in the weighing unit 11 in the present embodiment, the feeder driver 17 may be attached to the feeder 21 to which only a control signal is sent from the weighing unit 11.

As shown in Fig. 3, the weighing unit 11 has a weighing unit body 11a. The feeder 21 which is driven by the feeder driver 17 (Fig. 1) is attached to a top of the weighing unit body 11a. The stepping motor 18 (Fig. 1) of the weighing unit body 11a is provided with a switching device 18a for opening or closing a gate of a feed hopper 28. The feed hopper 28 is removably attached to the switching device 18a. The stepping motor 18 functions as switching means for the feed hopper 28. Similarly, the stepping motor 19 (Fig. 1) is provided with a switching device 19a for opening or closing a gate of a weighing hopper 29. The weighing hopper 29 is removably attached to the switching device 19a. The stepping motor 19 functions as switching means for the weighing hopper 29. In addition to the stepping motor, a solenoid, an air cylinder, a servo motor and the like can be used as the switching means for the hoppers 28 and 29. The motor drivers 14 and 15, the A/D converter 16 and the feeder driver 17 are controlled by the CPU board 13. For simplicity, only the weighing unit body 11a is shown in Fig. 2. While only the feed hopper 28 and the weighing hopper 29 are provided as described above, a memory hopper for holding a weighed article and the like can further be provided, for example.

As shown in Fig. 1, the weighing system 10 according to the present embodiment comprises a feed - discharge control section 27 for controlling feed and discharge of an article to be weighed. Fig. 4 shows a block structure of the feed - discharge control section 27. As shown in Fig. 4, the feed - discharge control section 27 includes a center vibrator unit 101 and a collecting gate unit 102.

The center vibrator unit 101 has a center vibrator 103 for feeding the article to be weighed to the feeder 21 of the weighing unit 11 by vibration, and a feeder driver 104 for driving the center vibrator 103. The feeder driver 104 regulates a quantity ofthe article fed from the center vibrator 103 to the feeder 21 (Fig. 3) under control of a CPU board 109. The center vibrator unit 101 has an A / D converter 106 for A / D converting a weighed value in a level sensor load cell 105 for weighing the article on the center vibrator 103. A digital value obtained by conversion is sent to the CPU board 109. The CPU board 109 is connected to the LAN cable 23 through a LAN interface 110. In the present embodiment, the center vibrator unit 101 is formed by the center vibrator 103, the feeder driver 104, the level sensor load cell 105, the A/ D converter 106, the CPU board 109 and the LAN interface 110. The CPU board 109 and the LAN interface 110 are shared with the collecting gate unit 102, which will be described below.

An optical sensor for product level detection and an optical sensor controller can be used in place of the level sensor load cell 105 and the A / D converter 106. The level sensor load cell 105 and the optical sensor for product level detection function as means for detecting an article to be weighed. The A / D converter 106 and the optical sensor controller function as digital converting means.

The collecting gate unit 102 has an collecting gate (not shown) provided in a lower portion of a chute 31 shown in Fig. 5 which will be described below. The collecting gate is opened or closed by a collecting gate motor 107 which acts as the gate switching means, and serves to store the article discharged from the weighing unit 11 and to discharge the same article to a packer in a predetermined timing. The collecting'gate motor 107 is driven by a motor driver 108 under control of the CPU board 109. In the present embodiment, the collecting gate unit 102 is formed by the collecting gate motor 107, the motor driver 108, the CPU board 109 and the LAN interface 110. The CPU board 109 and the LAN interface

110 are shared with the center vibrator unit 101 as described above.

Furthermore, the weighing system 10 according to the present embodiment is provided with a weighing control unit 26 connected to the LAN cable 23 through an optical fiber 25 and a photoelectric converter 24 as shown in Fig. 1. The weighing control unit 26 includes a weighing control section 26a, an operation indicating section 26b and a display section 26c formed of a LCD or the like. The weighing control section 26a has a memory 26d for storing an execution program and the like in the weighing driving section 12. The operation indicating section 26b causes the display section 26c to display a prompt screen, inputs switching times of the hoppers 28 and 29, delay times of various operation, and operating conditions of the feeder 21 and the like, and sets the same conditions to the CPU board 13 of the weighing unit and the weighing control section 26a. The operation indicating section 26b causes the display section 26c to properly display the weighed value of the article during operation, an average value thereof, a standard deviation, a weighing speed, hoppers used for a combination, operating conditions, an operation state, the contents of an alarm and the like. In the present embodiment, the weighing control section 26a performs single management of the whole weighing system 10. The photoelectric converter 24 can be housed in an I / O box or the like together with the feed - discharge control section 27 shown in Fig. 4, for example.

Actually, the weighing system 10 according to the present embodiment has an external structure shown in Fig. 5. As shown in Fig. 5, the weighing unit 11 is fixed around a center column 30, and the center vibrator 103 is fixed in the center on a top of the center column 30. The chute 31 is provided in a lower portion of the center column 30. The collecting gate (not shown) is provided below the chute 31. The packer (not shown) for packing the article to be weighed is provided below the collecting gate.

Fig. 6 shows an example of control information to be used by the LAN shown in Figs. 1 and 2. In the example of Fig. 6, control information of "04H, 4 * H" ("H" represents a hexadecimal number) are sent from the weighing control section 26a of the weighing control unit 26 to the LAN. "04H" is a header code which means an instruction issued from the weighing control section 26a to the weighing unit 11 and represents that the next instruction "4 * H" should be executed by the weighing unit 11. The instruction "4 * H" is a general term for instructions "40H to 43H" as shown in Fig. 6. The weighing unit 11 executes the instructions "40H to 43H" shown in Fig. 6.

The weighing unit 11 which has executed the instructions "40H to 43H" sends, to the LAN, response information including "84H, 4 * H, an A / D value and an error code" as shown in Fig. 6. "84H" means a response issued from a specific weighing unit 11 to the weighing control section 26a. "4 * H" means a response to a result of execution of the instructions "40H to 43H". The A / D value is data on a weight of the article. The error code represents a kind of malfunction generated by the weighing unit 11.

Since the weighing system 10 according to the present embodiment sends and receives the control information, the response information and the like through the LAN cable 23 at a high speed, it is excellent in quick response to the control information and the like. Furthermore, the weighing unit can be removed and attached during the operation.

In the present embodiment, the execution program of the CPU board 13 of the weighing driving section 12 is stored in the flash memory 13a as described above. If the execution program should be exchanged to perform the version up or the like, the program on which the version up has been performed is transferred from the memory 26d of the weighing control section 26a to the flash memory 13a ofthe weighing driving section 12 through the LAN cable 23 in the present embodiment. While the program for each weighing unit has been exchanged in the prior art, the version up can be performed on the program in a short time by using the structure of the present invention.

Furthermore, the weighing system 10 according to the present embodiment has a structure in which the weighing control section 26a detects abnormalities related to the LAN such as disconnection of the LAN cable 23 or failures of the LAN interface 22 when starting or during the operation. More specifically, the operating information necessary for the operation is sent from the weighing control section 26a to the CPU board 13 ofthe weighing unit 11 when starting, and it is judged that the weighing unit 11 to which a response signal is not sent within a constant time is abnormal. During the operation, various instructions are continuously sent from the weighing control section 26a to the CPU board 13 of the weighing unit 11, and it is judged that the weighing unit 11 to which a response signal is not sent within a constant time is abnormal. By this structure, abnormalities of the weighing system 10 related to the LAN can be detected easily.

While the CPU board 13 and the LAN interface 22 are provided separately in the present embodiment, both functions can be fulfilled by a single CPU board. Similarly, the CPU board 109 and the LAN interface 110 can be formed by a single CPU board.

Fig. 7 shows another embodiment of the weighing system according to the present embodiment. In the weighing system according to the present embodiment, a packer 40 is connected to the LAN cable 23 in the weighing system 10 shown in Fig. 1. According to the present embodiment, a weighing control section 26a also sets operating conditions to a packing driving section 81 ofthe packer 40, and an operation indicating section 26b also displays an operation state of the packer 40.

Fig. 8 shows a block structure of the packer 40. The packer 40 includes a heater 43 for longitudinal seal for

heat sealing a packing film 42 cylindrically, an air cylinder 44 for longitudinal seal for pressing the heater 43, a pull belt 45 for sending the cylindrical packing film 42 downward, a heater 46 for transverse seal for performing transverse seal after filling the fed article to be weighed, an air cylinder 47 for transverse seal for pressing the heater 46, and an air cylinder 49 for a cutter for driving the cutter which cuts the packing film 42 after performing the transverse seal. In the present embodiment, the heaters 43 and 46 are used as heating means, and the air cylinders 44 and 47 are used as seal pressing means. For example, a motor or the like can be used as the seal pressing means.

According to the present embodiment, the air cylinder 44 for longitudinal seal, the air cylinder 47 for transverse seal, the air cylinder 49 for a cutter, the pull belt 45, the heater 43 for longitudinal seal and the heater 46 for transverse seal are connected to driving control sections 64, 67, 69, 65, 79 and 80 respectively as shown in Fig. 8. The driving control sections 64, 67, 69, 65, 79 and 80 have CPU boards 64a, 67a, 69a, 65a, 79a and 80a, and LAN interfaces 64b, 67b, 69b, 65b, 79b and 80b, respectively. The LAN interfaces 64b, 67b, 69b, 65b, 79b and 80b are connected to the LAN cable 23. The driving control sections 64, 67, 69 and 65 connected to the air cylinder 44 for longitudinal seal, the air cylinder 47 for transverse seal, the air cylinder 49 for a cutter and the pull belt 45 have drivers 64c, 67c, 69c and 65c for driving them, respectively. The driving control sections 79 and 80 connected to the heater 43 for longitudinal seal and the heater 46 for transverse seal have temperature controllers 79c and 80c, respectively. In the present embodiment, the driving control sections 64, 67, 69, 65, 79 and 80 form the packing driving section 81.

In the present embodiment, the operation indicating section 26b ofthe weighing control unit 26 causes the display section 26c to display a prompt screen, inputs operating conditions such as a set temperature and an operation time of each seal section of the packer 40, an operation time of the cutter, delay times of various operation and the like, and sets the same conditions to the weighing control section 26a and the CPU boards 64a, 67a, 69a, 65a, 79a and 80a. The operation indicating section 26b causes the display section 26c to properly display a temperature of each seal section, a packing speed, the operating conditions, the contents of an alarm and the like. In the present embodiment, the weighing control section 26a also performs single management ofthe whole packer 40.

Since the packer 40 according to the present embodiment sends and receives the control information, the response information and the like through the LAN cable 23 at a high speed, it is excellent in quick response to the control information and the like. Furthermore, the system can easily be varied with a change in packing form, for example, air cylinders can easily be increased or removed and sensors can easily be added or removed.

In the present embodiment, execution programs of CPUs of the CPU boards 64a, 67a, 69a, 65a, 79a and 80a ofthe driving control sections 64, 67, 69, 65, 79 and 80 are stored in flash memories (not shown) on the CPU boards 64a, 67a, 69a, 65a, 79a and 80a, respectively. If the execution program should be exchanged to perform the version up or the like, the program on which the version up has been performed is transferred from the memory 26d of the weighing control section 26a to the flash memories of the CPU boards 64a, 67a, 69a, 65a, 79a and 80a through the LAN cable 23 in the present embodiment. By this structure, it is not necessary to exchange the program of each of the driving control sections 64, 67, 69, 65, 79 and 80, and a time taken to perform the version up can be shortened.

Furthermore, the weighing system according to the present embodiment has a structure in which the weighing control section 26a detects abnormalities related to the LAN such as disconnection of the LAN cable 23 or failures of the LAN interfaces 64b, 67b, 69b, 65b, 79b and 80b when starting or during the operation. By this structure, the abnormalities ofthe weighing system related to the LAN can easily be detected in the same manner as in the embodiment shown in Fig. 1.

While the CPU boards 64a, 67a, 69a, 65a, 79a and 80a and the LAN interfaces 64b, 67b, 69b, 65b, 79b and 80b are provided on the driving control sections 64, 67, 69, 65, 79 and 80 of the air cylinders 44, 47 and 49, the belt 45, and the heaters 43 and 46 respectively in the present embodiment, the CPU boards and the LAN interfaces can be collected together such that the air cylinders 44, 47 and 49, the belt 45, and the heaters 43 and 46 are controlled in one portion.

Since the weighing system according to the present invention has employed a structure in which the weighing driving section of the weighing unit is connected to the weighing control unit through the LAN capable of performing high-speed communication, it is excellent in quick response to the control information, the operating information and the like. By employing the LAN, the execution program of the weighing driving section can be exchanged at a high speed to perform the version up or the like. Furthermore, the function of the LAN is utilized so that abnormalities of the system related to the LAN can be diagnosed easily. In addition, weighing units can be increased or removed easily.

Although the present invention has fully been described by way of example with reference to the accompanying drawings, it is to be understood that various changes and modifications will be apparent to those skilled in the art. Therefore, unless otherwise such changes and modifications depart from the scope of the invention, they should be construed as being included therein.

Claims

1. A weighing system comprising:

   a plurality of weighing units forming a combination scale;
   a weighing driving section provided on each of the weighing units for causing the weighing unit to perform weighing operation;
   a weighing control unit including a weighing control section for controlling the weighing driving section, and an operation indicating section for setting operating conditions of the weighing system and for displaying an operation state; and
   a LAN for mutually connecting the weighing driving section and the weighing control unit.

2. The weighing system as defined in Claim 1, wherein the weighing control section of the weighing control unit has program transferring means for transferring an execution program to the weighing driving section through the LAN.

3. The weighing system as defined in Claim 1 or 2, wherein the weighing control section of the weighing control unit has a self-diagnostic function of detecting abnormalities of the LAN.

4. The weighing system as defined in any of Claims 1 to 3, wherein the weighing unit includes one or more hopper switching means for performing the weighing operation, and one or more load cells, and the weighing driving section includes a driver of the hopper switching means, and an A/D converter for A / D converting a weighed value in the load cell.

5. The weighing system as defined in Claim 4, further comprising a center vibrator unit connected to the LAN for feeding an article to be weighed to the weighing unit, the center vibrator unit including a center vibrator for feeding the article to the weighing unit by vibration, a feeder driver for driving the center vibrator, article detecting means for detecting a quantity of the article on the center vibrator, and digital converting means for converting an input sent from the article detecting means to a digital signal.

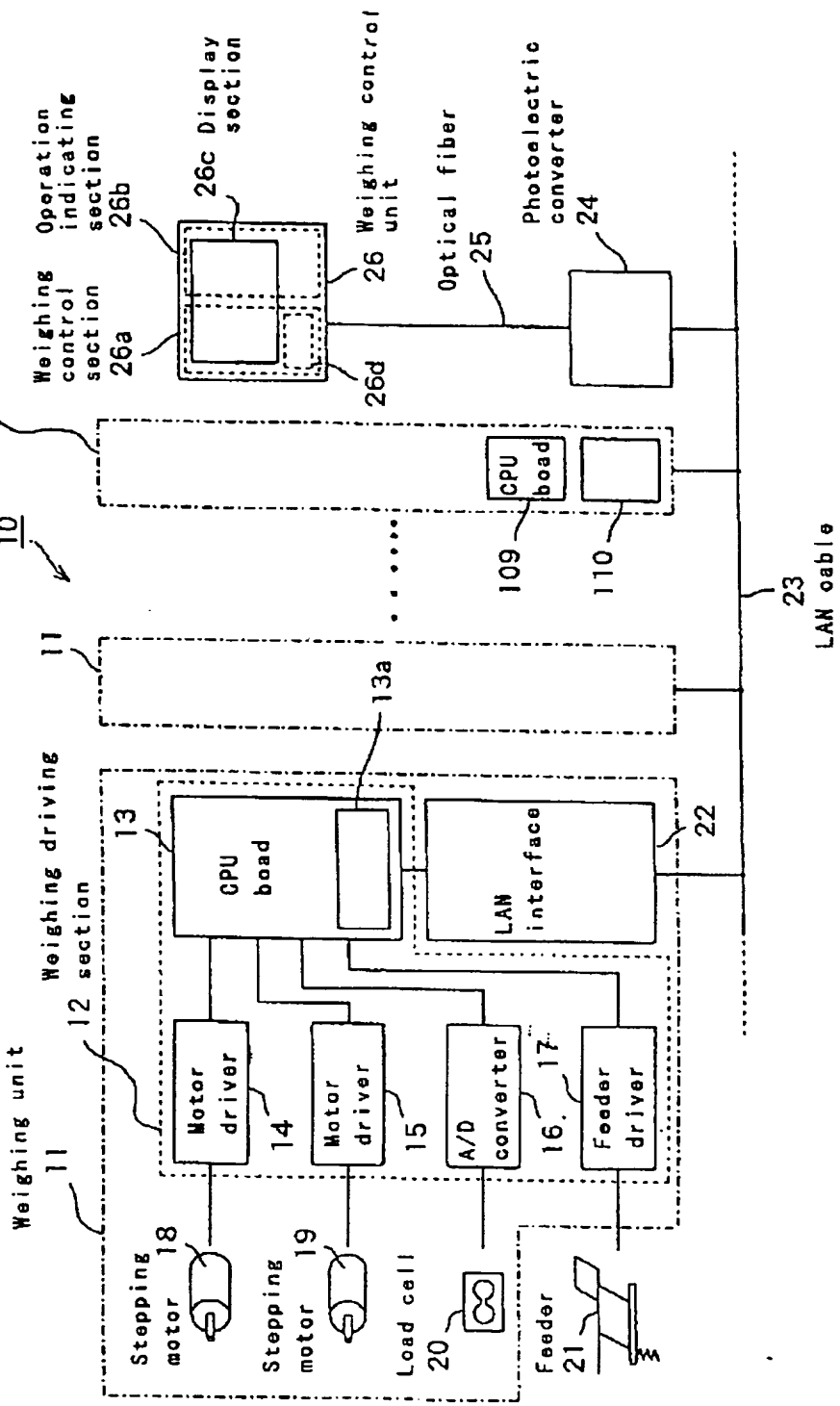
6. The weighing system as defined in Claim 4 or 5, further comprising an collecting gate unit connected to the LAN, the collecting gate unit including a driver for driving a collecting gate for storing the article discharged from the weighing unit and for discharging the same article in a predetermined timing, and gate switching means for controlling to open or close the collecting gate.

7. The weighing system as defined in any of Claims 1 to 6, wherein the weighing control section of the weighing control unit also sets operating conditions to a packing driving section provided on a packer for packing the article discharged from the weighing system, and the operation indicating section also displays an operation state of the packer.

8. The weighing system as defined in Claim 7, wherein the packer includes one or more seal pressing means for performing packing operation, one or more belts, one or more sensors, and one or more heating means, and the packing driving section includes a driver of the seal pressing means, a driver of the belt, a controller of the sensor and a temperature controller of the heating means.

9. A weighing system comprising a plurality of weighing units and a weighing control unit, wherein the weighing control unit is connected to each of the weighing units through a LAN.

Fig. 1


Weighing unit
11
Weighing driving section
12
13
CPU board
13a
LAN interface
22
Motor driver
14
Motor driver
15
A/D converter
16
17
Feeder driver
Stepping motor
18
Stepping motor
19
Load cell
20
Feeder
21
10
11
27 Feed-discharge control section
Weighing control section
26a
Operation indicating section
26b
26c Display section
26d
26 Weighing control unit
Optical fiber
25
Photoelectric converter
24
CPU board
109
110
23
LAN cable

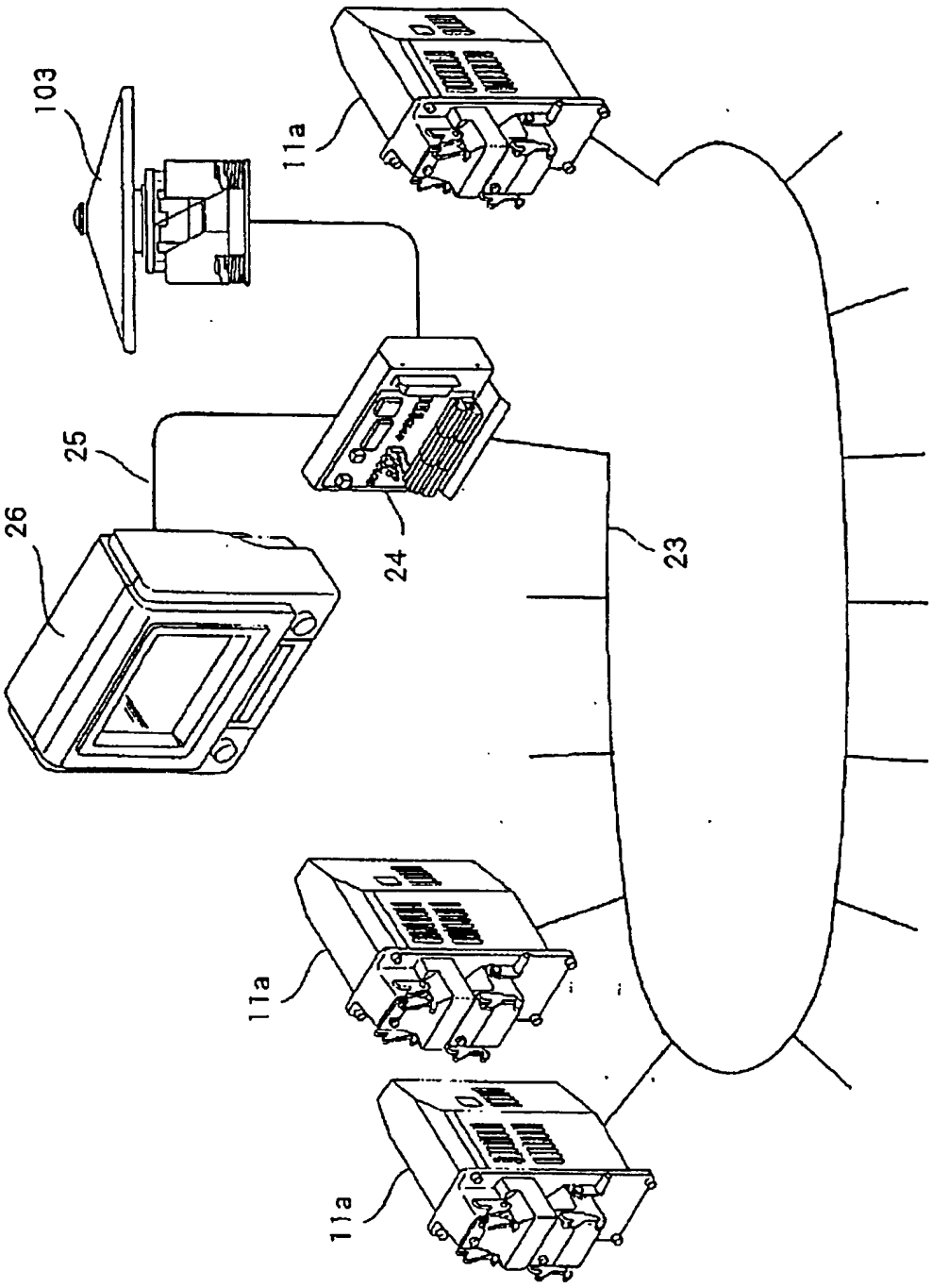


Fig. 2

Fig. 3

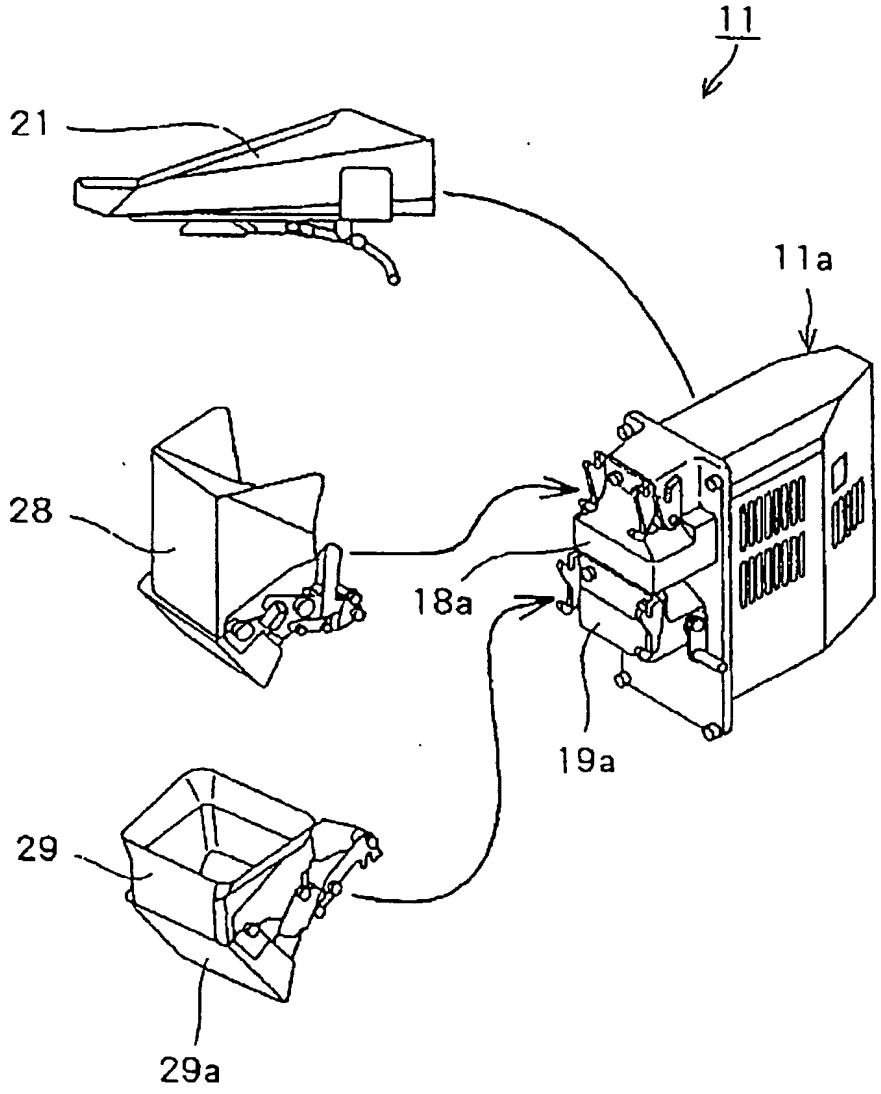


Fig. 4

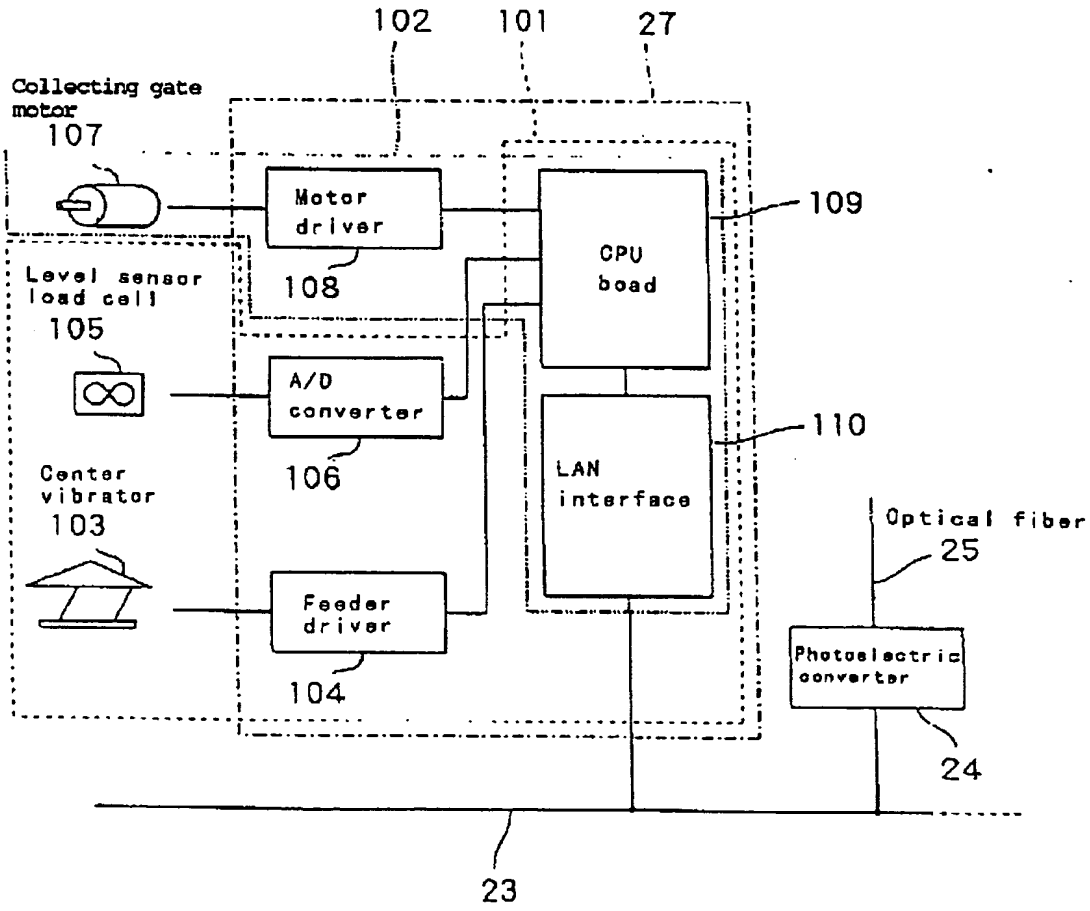

102
101
27
Collecting gate motor
107
Motor driver
108
CPU boad
109
Level sensor load cell
105
A/D converter
106
LAN interface
110
Center vibrator
103
Optical fiber
25
Feeder driver
104
Photoelectric converter
24
23

Fig. 5

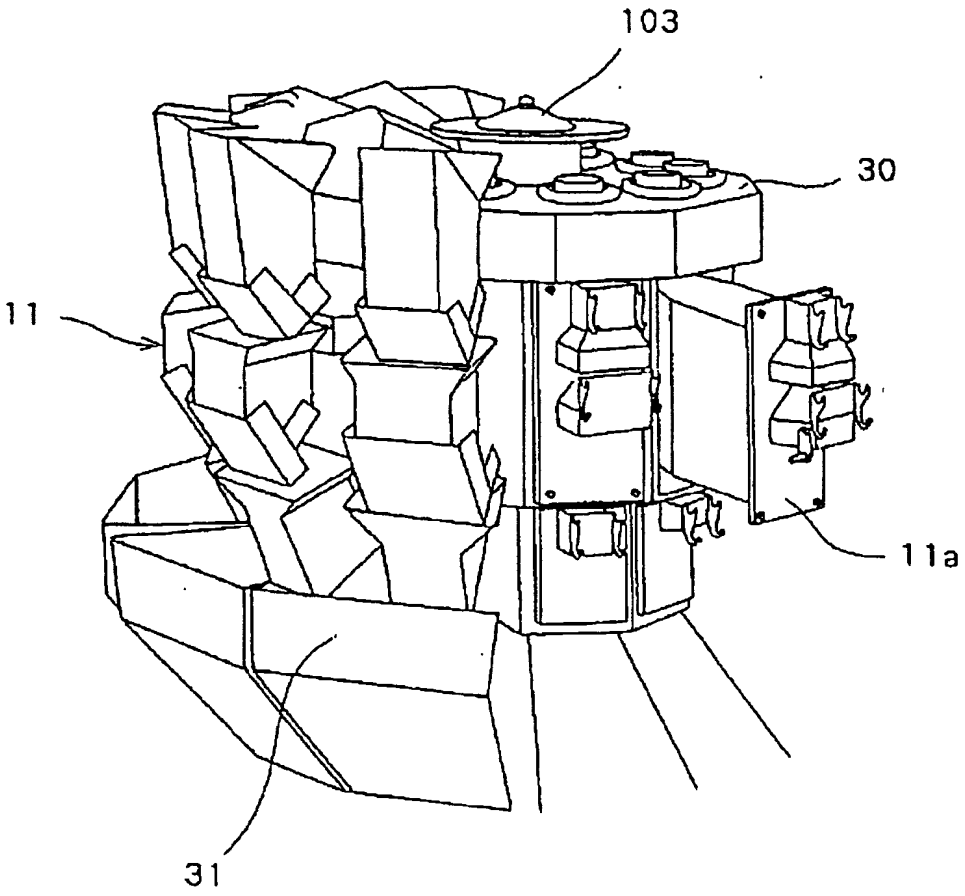
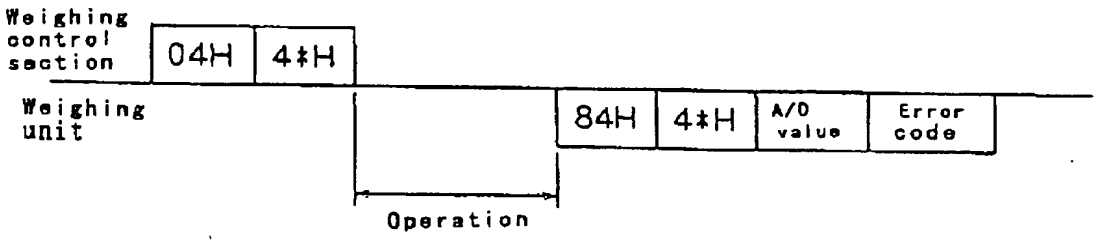


Fig. 6



Command: 4*H
40H = Start consecutive operation
41H = Start feeder 21
42H = Start feed hopper 28
43H = Start weighing hopper 29

Fig. 7

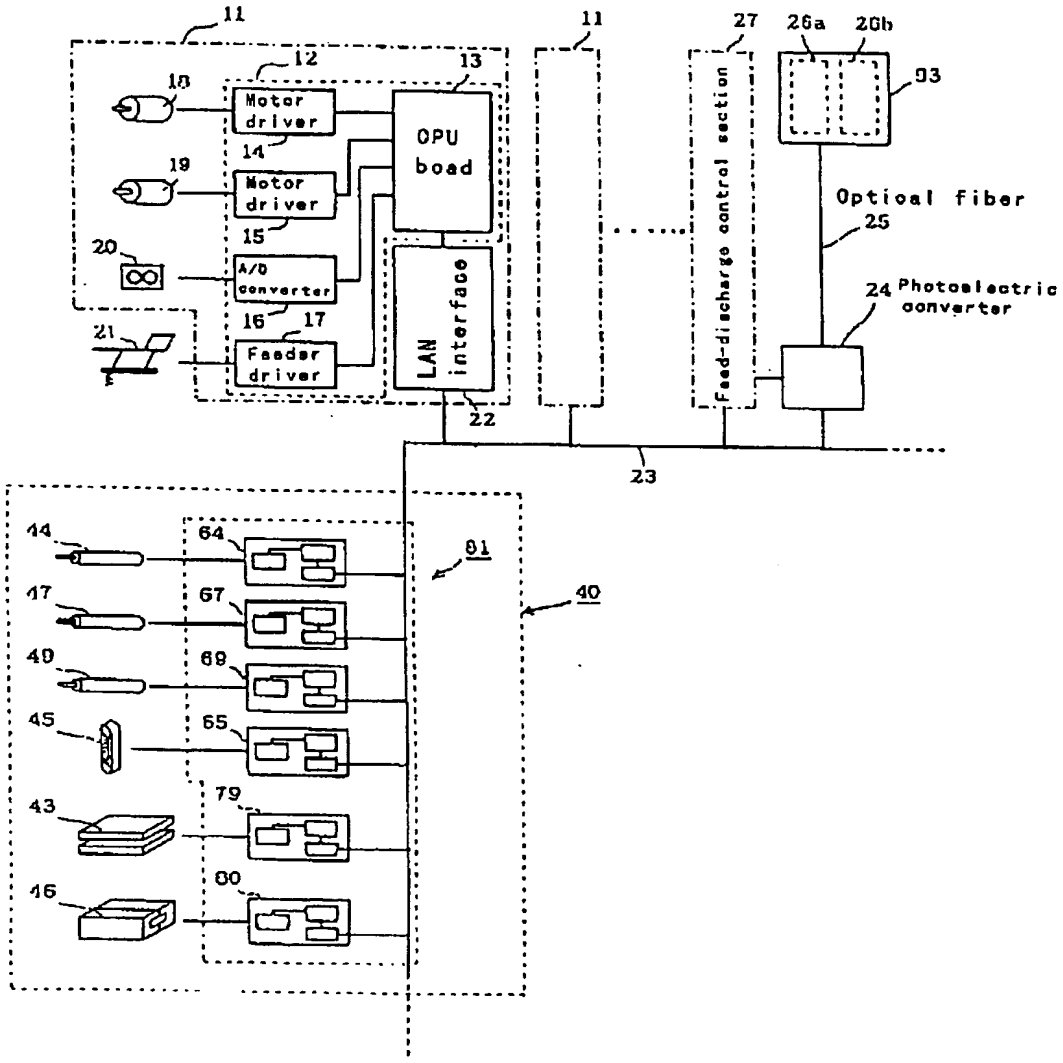
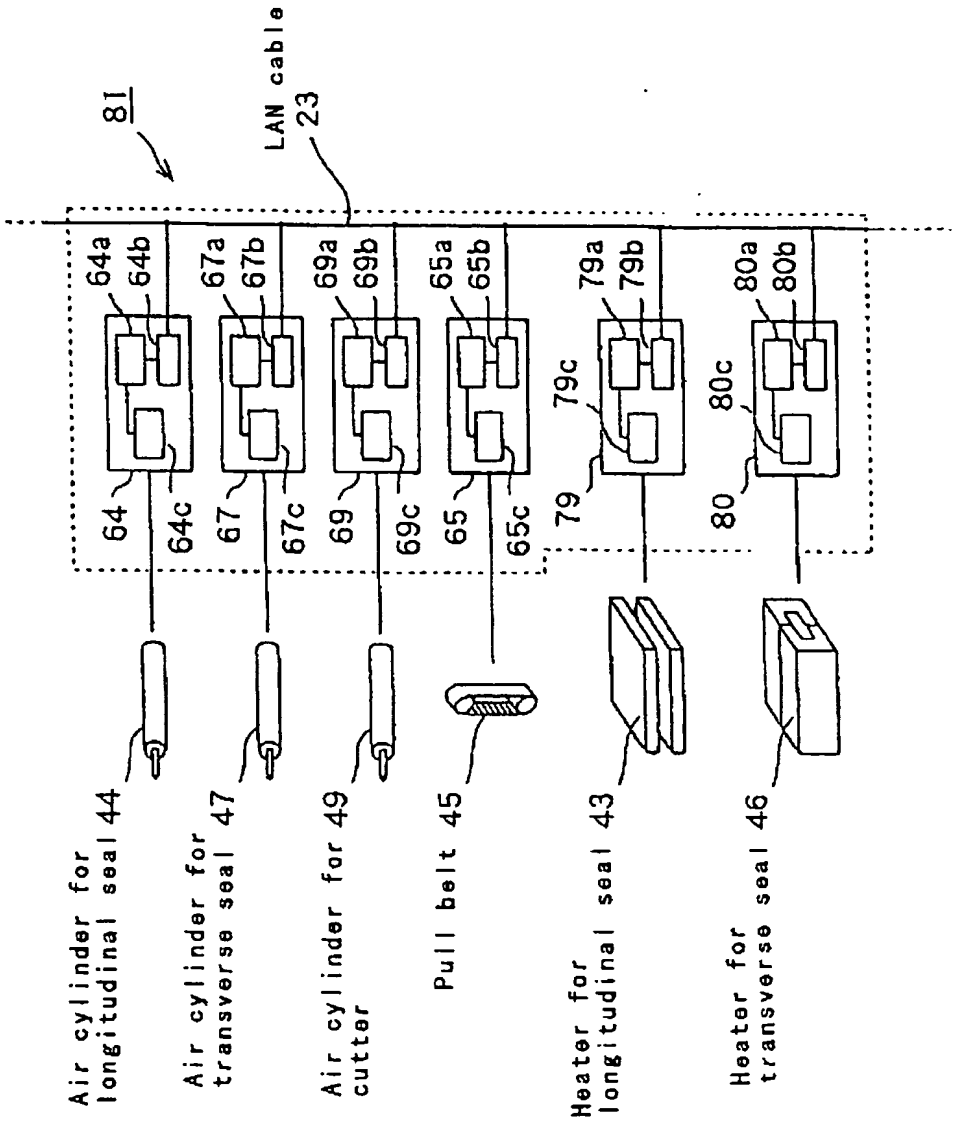

11
12
13
18
19
20
21
Motor driver
Motor driver
A/D converter
Feeder driver
14
15
16
17
OPU boad
LAN interface
22
11
27
Feed-discharge control section
26a
26b
93
Optical fiber
25
24
Photoelectric converter
23
44
47
49
45
43
46
64
67
69
65
79
60
91
40

Fig. 8


81
LAN cable
23
64a
64b
67a
67b
69a
69b
65a
65b
79a
79b
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79c
80c
64
64c
67
67c
69
69c
65
65c
79
80
Air cylinder for longitudinal seal 44
Air cylinder for transverse seal 47
Air cylinder for 49 cutter
Pull belt 45
Heater for longitudinal seal 43
Heater for transverse seal 46